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CHICAGO 16, ILLINOIS

GAS ABSTRACTS

APRIL, 1956

VOLUME 12, NUMBER 4

AFFILIATED WITH

ILLINOIS INSTITUTE OF TECHNOLOGY

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GAS ABSTRACTS is published and distributed monthly by the Institute of Gas Technology, Chicago 16, Illinois. The contents of selected papers and patents are reviewed impartially by the editorial staff and material of potential interest to the Gas Industry is presented. Subscription rates to non-members of the Institute: $18.00 per year to U.S. addressees; $22.00 foreign.—Printed in the U.S.A.

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1. GAS INDUSTRY

Education

Polakowski, N. H. TRAINING OF TECHNICAL AND SCIENTIFIC MANPOWER IN THE U.S.S.R. *Metal Progress*, **69**, 68-72 (1956) January.

Counting his pre-college education, a Russian boy or girl can become an engineer for industry or for research in 15 years. If he reaches that goal via a technical high school it takes four years longer. There is strong competition for such opportunities, but self-critcism appearing in Soviet journals indicates that graduates are usually too highly specialized for jobs requiring a broad general background rather than detailed knowledge of a narrow field.

Author's Abstract

Energy Resources

A. Parker. POWER, POPULATION, AND PROPERITY: THE MELCHETT LECTURE FOR 1955. *J. Inst. Fuel* (British) **29**, 3-10 (1956) January.

Following a review of world resources in coal, lignite, petroleum, gas, oil shale and peat as capital resources of energy, the author discusses energy consumption, its growth from 1950 to 1954, and other possible energy sources (atomic, solar, wood, water) and cost of production. The situation of Great Britain, the future of population growth and energy demand is summarized as a productivity problem.

O. P. Brysch

FPC Regulation

Fulbright, J. W. THE FPC GAS PRODUCER EXEMPTION IS IN THE CONSUMER'S INTEREST. *Public Utilities Fortn.*, **57**, 13-16 (1956) January 5.

Senator Fulbright defends the position that gas producers should not be regulated.

W. G. Bair

Public Relations

Merriam, J. F. NEW HORIZONS AHEAD FOR GAS. *Gas Age*, **117**, 35 (1956) January 12.

A short article by the president of the Northern Natural Gas Company calling for gas industry teamwork in informing the public about the industry.

R. F. Bukacek

Cushman, J. A. AGA PUBLIC INFORMATION PROGRAM REDOUBLES EFFORTS. *Gas*, **32**, 58, 59, 62 (1956) February.

A report of the work being done by AGA to get facts and materials to gas companies that will be useful to stop the growing trend toward government ownership and subsidy of gas distribution systems.

C. A. Simms

Ratable Production

RATABLE GAS TAKE NEARER. *Oil Gas J.*, **54**, 62 (1956) January 9.

The Texas Railroad Commission is moving cautiously to attain ratable take for gas. In January a second field, the Waskom in East Texas, was placed under proration. The Commission is searching for a "fair" set of rules for establishing the proration, and is using this field as a guinea pig.

B. E. Eakin

Retail Gas Costs

RISING COSTS IN THE GAS DISTRIBUTION INDUSTRY. *Public Utilities Fortn.*, **57**, 113-18 (1956) January 19.

The article reviews the factors that affect the rising cost of gas to the retail customer, other than raw material costs.

W. G. Bair

Russian Gas Industry

Adams, C. P. USSR PUSHES NATURAL GAS INDUSTRY. *Petroleum Eng.*, **27**, E3, 6, 8 (1955) December.

A discussion of the Russian natural gas industry based on numerous quotations from the Soviet press. Although very backward to date, a second pipeline (500 miles long) to Moscow was completed in 1955, and a third line of 700 miles is under construction. Great expansion is promised in the sixth 5-year plan, although need of much improvement in pipe, heavy machinery and appliances is admitted.

R. F. Bukacek

Solar Energy

Chaney, N. K. SOLAR ENERGY AND THE GAS INDUSTRY. *Amer. Gas Assoc. Monthly*, **38**, 12-13, 36-37 (1956) February.

A brief summary of the present accomplishments in applied solar energy are reviewed. The author believes that solar energy offers no economic competition with conventional fuels at present prices.

J. G. Chalcraft

2. APPLIANCES

Burners

Anderson, F. T. (assigned to Modern Materials Co.) GAS BURNER CONSTRUCTION. U. S. 2,728,384 (1955) December 27.

Goulding, C. E., Sr. OPEN FLAME HEATING UNIT WITH COMBUSTION AIR PREHEATING MEANS. U. S. 2,733,705 (1956) February 7.

Controls and Ignition

Cobb, C. A. (assigned to Penn Controls, Inc.) GAS BURNER CONTROL. U. S. 2,731,080 (1956) January 17.

Deubel, J. A. (assigned to General Controls Co.) GAS BURNER CONTROL SYSTEM. U. S. 2,730,169 (1956) January 10.

Gorham, G. and Grageroff, I. SAFETY DEVICE FOR GAS BURNING APPLIANCES. U. S. 2,729,221 (1956) January 3.

Homann, W. DEVICE FOR SHUTTING-OFF AND REGULATING A GAS-FLOW FOR HEATING, BURNING AND/OR COOKING PURPOSES. U. S. 2,728,385 (1955) December 27.

Lundgren, J. L. (assigned to Geo. D. Roper Corp.) GAS BURNER IGNITION APPARATUS AND VALVE THEREFOR. U. S. 2,733,758 (1956) February 7.

Lundgren, J. L. and McCammant, L. H. (assigned to Geo. D. Roper Corp.) GAS BURNER IGNITION SYSTEM. U. S. 2,733,760 (1956) February 7.

Lundgreen, J. L. (assigned to Geo. D. Roper Corp.) TOP BURNER IGNITION SYSTEM. U. S. 2,733,761 (1956) February 7.

McCammant, L. H. (assigned to Geo. D. Roper Corp.) BURNER CONTROL AND ELECTRIC IGNITION SYSTEM FOR STOVES. U. S. 2,733,759 (1956) February 7.

Ray, W. A. (assigned to General Controls Co.) SHUT-OFF VALVE SYSTEM. U. S. 2,729,285 (1956) January 3.

Russell, W. J. (assigned to Robertshaw-Fulton Controls Co.) SAFETY CONTROL FOR GASEOUS FUEL BURNERS. U. S. 2,726,716 (1955) December 13.

Strobel, C. K. (assigned to Robertshaw-Fulton Controls Co.) FLAME FAILURE AND IGNITION CONTROL FOR FUEL BURNERS. U. S. 2,726,717 (1955) December 13.

Thornbery, J. H. (assigned to Milwaukee Gas Specialty Co.) GAS REGULATING DEVICE. U. S. 2,728,386 (1955) December 27.

Cooking Range

Feder, A. G. (assigned to Welbilt Corp.) COOKING RANGE. U. S. 2,733,706 (1956) February 7.

Space Heaters

Giwosky, H. L. (assigned to The Coleman Co., Inc.) FORCED AIR FLOW COMBUSTION HEATER FOR SPACE HEATING. U. S. 2,733,704 (1956) February 7.

Myers, B. V. SPACE HEATER. U. S. 2,734,500 (1956) February 14.

Commercial Range Tops

Hammacker, F. G., Jr. HEAT APPLICATION TO COMMERCIAL RANGE HEAVY-DUTY TOP SECTIONS. PART I—OPEN TOP RANGES. Amer. Gas Assoc. Lab. Research Report No. 1239 (1955) August.

An engineering analysis made by the American Gas Association Laboratories, covering the merits of atmospheric burner applications to top sections of heavy-duty open top commercial ranges, indicated that improved cooking performance could be obtained by increasing the heat input rate of the burners. On the basis of this analysis, experimental installations of a modified contemporary atmospheric burner in a heavy-duty open top range were employed to demonstrate that substantial increases in preheating speeds could be attained with only a slight decrease in thermal efficiency by increasing the normal fuel input rate to the burners by as much as 70 percent. Thus, appreciable time could be saved in over-all cooking operations. This publication represents the initial work done under the research project, designated as project IA-5, "A Study of Various Methods of Heat Application to Commercial Range Heavy-Duty Top Sections", sponsored by the American Gas Association's Committee on Industrial and Commercial Gas Research as a PAR plan activity. Author's Abstract

Heating Service

MINNEAPOLIS GAS COMPANY ANALYZES CAUSES OF SERVICE. *Gas Heat*, 6, 39-42 (1955) October.

Main causes for service of gas heating are named as dust, dirt and lint, according to an analysis of service calls completed by the Minneapolis Gas Company. Parts of the system most often attacked are the pilot light and the thermostat. From a total 65,900 service calls tabulated on four classes of equipment (water heaters, space heaters, central heating, and gas dryers) 30% were caused by pilot light trouble and another 13.2% were caused by thermostats. Foreign matter was the cause of 30% of all pilot difficulty and accounted for nearly 57% of the service calls on thermostats.

J. G. Chalcraft

Clothes Dryers

AMPLE SHARE OF 5.5-MILLION-UNIT HOME LAUNDRY MARKET IS STILL OPEN TO GAS CLOTHES DRYER SALES. *Butane-Propane, News*, 17, 26-27 (1955) December.

The sales of home laundry appliances for the past 10 years are discussed, comparing the gas appliances with the electric ones.

J. G. Chalcraft

Deep Fryer

Beardsley, R. L.. GAS HELPS COOK A FINE KETTLE OF FISH. *Ind. Gas*, 34, 12 (1956) January.

A specially designed deep fat fryer, replacing an inadequate electric type, turns out 100 lbs. of frozen fish sticks per hour; close temperature tolerance keeps oil usable for a week.

Author's Abstract

Refrigeration

Whitlow, E. P. (assigned to Servel, Inc.) ABSORPTION REFRIGERATION APPARATUS. U. S. 2,729,952 (1956) January 10.

A vacuum-type absorption refrigeration system comprised of concentric shells and contained within a cylindrical shell is described. Simplification of parts and less possibility for leaks is claimed. R. T. Ellington

Separate Ovens

McCullough, H. E. and Schoeppel, M. S. SEPARATE OVENS. Small Homes Council Circ. C5.33, Univ. Illinois Bull. 53, No. 36 (1956) January.

The advantages of separate ovens and factors to be considered in placing them in the kitchen are discussed in a way that should be of considerable interest to domestic sales people.

R. T. Ellington

Utilization Developments

Corfield, G. DEVELOPMENTS IN GAS UTILIZATION DURING THE PAST DECADE. *Gas*, 32, 48-50 (1956) January.

A discussion of improvements and modifications made during the past decade in gas utilization methods and equipment. J. G. Chalcraft

Wall Heaters

PERFORMANCE TEST FOR GAS-FIRED WALL HEATER IN BASEMENTLESS HOUSE. *Amer. Gas J.*, 182, 18-19 (1955) August.

An investigation made by the National Bureau of Standards of the performance of a gas-fired wall heater in a basementless house to determine the temperature distribution produced by typical gravity circulation of air or by using a small booster fan. Horizontal and vertical-temperature gradients were observed as a basis for judging the acceptability of this type of heating system for various climates and for houses of different sizes. J. G. Chalcraft

3. COMBUSTION AND INDUSTRIAL FURNACES

Automobile Exhaust Clean-up

Deliman, G. AUTOMOBILE ACCESSORY FOR BURNING EXHAUST GASES. U. S. 2,728,408 (1955) December 27.

To eliminate unburned hydrocarbon gases from automobile exhaust gas, a fitting comprising a ceramic sleeve with air ports and insulated high-tension electrodes is fitted to the exhaust pipe, and a high potential (induction coil) current is passed to generate a continuous spark to burn combustibles. O. P. Brysch

Batch Furnaces

Neumeyer, M. MECHANIZED BATCH TYPE FURNACES. *Ind. Heating*, 22, 2444-64, (1955) December.

Advantages of using batch equipment are being supplemented through advances in automatic processing techniques. Automatic batch furnaces and their operation are described and illustrated in this article. Author's Abstract

Flame Research

Dixon-Lewis, G. THE INTERNAL STRUCTURE OF FLAME REACTION ZONES. Gas Council (British) Res. Comm. GC29 (1955) November 22.

The current experimental knowledge of temperature and composition variations in flames is reviewed. The fundamental equation describing burning behavior are discussed.

S. A. Weil

Patrick, C. R. and Robb, J. C. THE INITIATION STEP IN THE THERMAL HYDROGEN + OXYGEN REACTION. *Faraday Soc. Trans.* (British), 51, 1697-1703 (1955) December.

The thermal and mercury-photosensitized reactions of equimolar H_2-O_2 mixtures were studied at 500-600° C. The results indicate that the initiation step in the thermal reaction is inhibited by water vapor. A mechanism is postulated in which the rate of initiation is determined by the rate of evaporation of H_2O_2 found at the walls. The adsorption of water on the walls reduces the area available for formation of the peroxide. S. A. Weil

Potter, A. E., Jr. and Berlad, A. L. THE QUENCHING OF FLAMES OF PROPANE-OXYGEN-ARGON AND PROPANE-OXYGEN-HELIUM MIXTURES. *J. Phys. Chem.*, 60, 97-101 (1956) January.

The quenching conditions for propane-argon 'air' and propane-helium 'air' flames were determined. The variables considered were equivalence ratio (0.47 to 2.07) and pressure (0.2 to 1 atm.). Equations are presented for prediction of quenching distance based on diffusional and on thermal quenching. The ratio of quenching distances for the two types of flame agreed more closely with those predicted by the thermal equation. S. A. Weil

McKinley, J. D., Jr., and Garvin, D. THE REACTIONS OF ATOMIC HYDROGEN WITH OZONE AND WITH OXYGEN. *J. Amer. Chem. Soc.*, 77, 5802-05 (1955) November 20.

The mechanism and intermediates of the reaction at room temperature and low pressure are discussed in light of the products trapped by liquid nitrogen. The proposed mechanism would apply to systems involving the dissociation of water or peroxide. S. A. Weil

Industrial Heating

Delchroix, J. EXTRUDING METAL WITH GLASS LUBRICANTS. *Metal Progress*, 69, 57-60 (1956) January.

Use of glass-wool "sock" or powdered glass as lubricant between hot billet and chamber and die in an extrusion press gives much easier and faster working conditions, better surface on the extrusion, requires less power, and vastly increases the adaptability of the process. Scale-free heating of the billet remains a difficult problem. Author's Abstract

Smith, A. Q. SPEEDING MANUFACTURE OF PORCELAIN ENAMEL. *Ind. Gas*, 34, 6, 7, 23, 24 (1956) January.

The Texlite, Inc. Co. of Dallas, Texas, turns out signs and structural pieces, doing all its own work from the initial grinding of enamel. Wide use of porcelain enamel products has been made possible by mass production methods, leading to competitive pricing. J. G. Chalcraft

Odor Control

UP THE THE AIR OVER ODOR CONTROL. *Chem. Week*, 78, 98, 101 (1956) January.

Methods for measuring and controlling odor used by Procter and Gamble Co. are discussed.

D. M. Mason

Oven Explosion Reliefs

Cubbage, P. A. and Simmonds, W. A. AN INVESTIGATION OF EXPLOSION RELIEFS FOR INDUSTRIAL DRYING OVENS. I—TOP RELIEFS IN BOX OVENS. Gas Council (British) Research Comm. GC23 (1955) November.

Explosions of town gas and air mixtures in

drying ovens have been studied in order to develop bases for design of reliefs. Empirical formulas have been derived relating oven volume, venting area and weight of relief with the pressure developed by the most violent mixture. This 46-page booklet, limited to top reliefs in box ovens, is the first in a series of such investigations. Pressure-time variations in an oven during an explosion were found to be complicated, and to consist of two pressure peaks, reasons for which are discussed. Position of ignition was not found to be important. Effect of vigorous stirring was to increase the pressures developed up to 50%. Measurements of the flame spread were made to establish the space around the oven to avoid. Formulas are given from which the height and horizontal extent of the flame may be calculated. Construction details of a suggested safe relief are provided.

E. B. Shultz

Power Costs

Harlow, J. H. PROJECTED COST OUTLOOK FOR CONVENTIONAL POWER. *Combustion*, 27, 34-36 (1956) January.

New fuels and new methods of power generation quite naturally engender enthusiastic proponents. At times, however, economic reality must be introduced to bring the picture into perspective and balance. This is what an experienced power engineer whose company is actively engaged in pioneering ventures in power plants utilizing both conventional and nuclear fuels has sought to accomplish in this article.

Author's Abstract

SO_2 Removal

Keller, J. L. (assigned to Union Oil Co. of California) REMOVAL OF SULFUR DIOXIDE FROM GASES CONTAINING THE SAME. U. S. 2,729,543 (1956) January 3.

This invention relates to the Keller process for removing SO_2 from flue gas by absorption in an aqueous solution followed by reaction of the dissolved SO_2 with H_2S to yield elemental sulfur. Advantageous conditions of the process including method of adding H_2S pH of the solution, and particularly the temperature of absorption and regeneration, are disclosed.

D. M. Mason

Turbine Scale

Simons, E. L., Browning, G. V. and Liebhafsky, H. A. SODIUM SULFATE IN GAS TURBINES. *Corrosion*, 11, 505t-5141 (1955) December.

Sodium sulfate forms when residual fuels are burned in gas turbines. Its presence in the deposits which may appear on the working surfaces has undesirable physical and chemical effects. The physical effects are discussed in terms of sintering and melting. The chemical effects considered are the various possible corrosion reactions. Although all of these reactions are complex, simplified mechanisms for them are proposed, which are consistent with the experimental results and with general experience. In particular, the violent destruction of a high temperature alloy by sodium sulfate in large excess is attributed to the triggering of an auto-catalytic reaction involving this salt. Even with thin films of sodium sulfate, enhanced oxidation is observed when the atmosphere is alternately reducing and oxidizing. The following mechanism is suggested for this enhancement. Lower-valent sulfur produced in a reducing environment leads to the formation of a liquid metal-metal sulfide eutectic, which penetrates the alloy. The metal dissolved in this eutectic is more rapidly oxidized by atmospheric oxygen than is the sulfur-free alloy. Sodium sulfate itself appears to be innocuous so long as all lower-valent sulfur is absent. Because sodium sulfate will be formed from any sodium compound present in residual fuels, the General Electric Gas Turbine Department has undertaken large-scale measures to remove sodium compounds from the fuels before combustion. Results so far are promising.

Authors' Abstract

Turbocharged Engines

Chamberlain, C. A. and Bollman, G. H. TURBOCHARGING TWO STROKE GAS ENGINES. *Petroleum Eng.* 27, D26-28, 31-32, 34 (1955) December.

A discussion of the use of turbochargers to obtain lower fuel consumption and higher power output from 2 cycle gas engines.

G. G. Wilson

4. CARBONIZATION AND GASIFICATION

Carbon Desulfurization

McKinley, J. B. and Henke, A. M. (assigned to Gulf Research and Development Co.) PRODUCTION OF LOW SULFUR SOLID CARBONACEOUS FUELS. U. S. 2,726,148 (1955) December 6.

This invention relates to a process for desulfurizing dense solid carbonaceous materials by contacting with hydrogen at pressures of above atmospheric and temperatures of 300-425°C resulting in the reduction of pyritic sulfur (and perhaps sulfur in other forms) to the easily removable form, hydrogen sulfide.

K. C. Channabasappa

Carbon Groups

Miron, S. TYPE CARBON ATOM ANALYSIS OF HEAVY HYDROCARBON PRODUCTS. *Anal. Chem.*, 27, 1947-56 (1955) December.

A method is described for determining the percentages of aromatic, naphthenic, and alkyl carbon atoms in hydrocarbon products having molecular weights above 150. This method may be used on highly olefinic materials, and does not require the assumptions that the rings present are six-membered and kata-condensed. Selective hydrogenation is used to differentiate between olefinic and aromatic double bonds. The ring content is computed from the molecular formula after complete hydrogenation. The ring size is determined by using the density-molecular weight correlations of Kurtz and Linkin. In some cases the extent of ring condensation is estimated from an equation based on measurable quantities; in other cases it is assumed that 50% of the condensable ring carbon atoms are condensed. The errors which may result from the use of this method are shown to be generally less than the errors caused by assuming six-membered, kata-condensed rings. Authors' Abstract

Coal Properties

Hiorns, F. J. SOME MECHANICAL PROPERTIES OF COAL (Review No. 153). *Brit. Coal Utilizn. Res. Assoc. Monthly Bull.* 19, 533-43 (955) November.

This review discusses the measurements of the breaking strength and the elastic and rheological properties of coal. Studies of mechanical properties of coal in general have been neglected because of difficulties in preparing test specimens, heterogeniety of coals and difficulties of interpretation of results. Data available are discussed for 1) static tests (compression), 2) static loaded elastic modulus, 3) dynamic loaded elastic modulus and 4) rheology or non-elastic behavior. Anistropic effects, influence of coal rank, moisture content, and relationship to chemical properties are summarized, with citation of 28 references. O. P. Brysch

Zwietering, P., Overeem, J. and van Krevelen, D. W. CHEMICAL STRUCTURE AND PROPERTIES OF COAL XIII—ACTIVATED DIFFUSION OF GASES IN COAL. *Fuel* (British) 35, 66-70 (1956) January.

The rate of sorption at constant pressure and far from equilibrium was measured at temperatures of about 150° K. Additional data were calculated from measurements at room temperature and constant volume. The diffusion coefficient of methane in coal appears to be very small (about 10^{-12} cm^2/sec at room temperature). The activation energy of diffusion amounts to 3.9 kcal/mole. Authors' Abstract

Coke Ovens

Blecher, F. ENTWICKLUNGSLINIEN DES MODERNEN KOKSOFENBAUES UND IHRE ANWENDUNG IM REGELSTROMOFEN. (DEVELOPMENT LINES OF MODERN COKE OVEN CONSTRUCTION AND THEIR APPLICATION IN FLOW-CONTROLLED OVENS. *Erdoel und Kohle*, 8, 880-83 (1955) December.

After an introductory discussion of the importance of uniform heating of coke ovens, the author describes the controlled-flow oven (Regelstromofen). In this oven, uniform heating is obtained by more complete control of the gas flow, achieved primarily by a subdivided sole-flue and regenerator system. Each partial sole-flue feeds (or vents) its particular regenerator section, which in turn supplies a particular flue or flue-pair. By sliding brick and port adjustments, each sectionalized portion can be set at an optimum heating rate, for pre-heating the combustion air or handling the waste gases. The method can be applied in underjet and gas-gun under-firing systems. O. P. Brysch

Dougill, G. and Nelson, A. C. COKE OVENS AS GAS-MANUFACTURING PLANT. Instn. Gas Engrs. (British) Publn. No. 471 (1955) November 9; *Gas J.* (British) 284, 515-18, 521, November 23; 659-60 (1955) December 7; *Gas World* (British) 142, 1294-99, November 19; 1452-56 (1955) December 3.

A history is given of the experience of the Gas Light and Coke Co. and the North Thames Gas Board with the use of coke ovens as gas-manufacturing equipment. Since the installation of 2 Koppers-Becker batteries in 1932 at the Beckton Works, the plant has grown to 5 batteries, carbonizing 3000 tons coal per day and producing 37.5 MMCF gas per day. Comparisons are given with costs of gas from continuous and intermittent verticals, and horizontal retorts. Problems of coal behavior, gas purification, corrosion, heating, regenerator deposits, producer plants are discussed. O. P. Brysch

De-agglomerating Process

Garbo, P. W. (assigned to Hydrocarbon Research, Inc.) PROCESS FOR RENDERING SOLID CARBONACEOUS MATERIALS NON-AGGLOMERATIVE. U. S. 2,729,597 (1956) January 3.

This patent describes a novel method of causing a coating at 600-750°F of finely divided carbon, such as soot, lamp-black or carbon black carried in suspension in a gaseous stream, substantially non-oxidizing in character, on the particles of solid carbonaceous particles having a strong caking tendency to render them substantially non-caking in character. The coating can be achieved by either passing the solid and gaseous streams countercurrently in a kiln or by dropping the solid carbonaceous particles in rough a tower against an ascending gaseous stream carrying finely divided carbon. The required powdered carbon is produced by partial combustion of a hydrocarbon oil or gas in a carbon generator. K. C. Channabasappa

Garbo, P. W. (assigned to Hydrocarbon Research, Inc.) FLUIDIZED BED COATING OF COAL WITH NON-AGGLOMERATIVE MATERIAL. U. S. 2,729,598 (1956) January 3.

The patent describes a novel method of causing a coating at temperatures of 600-750°F with such non-agglomerating materials as fine sand, clay, diatomaceous earth, beutonite, fly ash, slate dust or powdered talc of solid carbonaceous material having a strong caking tendency to prevent agglomeration of coking coals in gasification units, when fed directly. The coating can be achieved either passing the solid and gaseous streams countercurrently in a kiln or by dropping the solid carbonaceous particles through a tower against an ascending gaseous stream carrying finely divided non-agglomerating material. Nitrogen, oxygen, steam, carbon dioxide and hydrogen are used as gaseous medium. K. C. Channabasappa

Fluidized Gasification

Nelson, K. J. and Gornowski, E. J. (assigned to Esso Research and Engineering Co.) PROCESS OF CONTACTING GASIFORM CARBONACEOUS SOLIDS. U. S. 2,729,552 (1956) January 3.

This invention relates to a method for gasifying pulverized carbonaceous solids such as coal in a fluidized state with provision for controlling the concentration of particles of —40 microns size at a level which will provide smooth fluidization and prevent excessive solids entrainment and particle agglomeration.

E. J. Pyrcioch

H_2S Removal

Moore, D. B. RECENT DEVELOPMENTS IN GAS PURIFICATION. *Gas World* (British), 143, 153-55 (1956) January 14.

The Gastechnik purification process, first patented in 1927, is now in operation in over 60 plants in Europe. The essential feature of the process is that tall cylindrical towers are filled with special iron oxide pellets, forming a continuous compact bed. The pellets flow easily under gravity and can be charged and discharged from the tower by means of gas locks without interrupting gas flow. The process is described together with a discussion of advances in other directions. D. M. Mason

Hydrogenation

Rottig, W. (assigned to Ruhrchemie A-G.) CATALYTIC HYDROGENATION OF CARBON MONOXIDE. U. S. 2,731,486 (1956) January 17.

New catalysts for carbon monoxide hydrogenation at atmospheric pressure are described as

being of the precipitated iron type, impregnated with polybasic acids such as water-glass, primary potassium phosphate, or potassium borate.

E. B. Schultz

Lignin-Coal Chemistry

Fuchs, W. DER GEGENWAERTIGE STAND UNSERER KENNTNIS DES LIGNINS UND SEINER BEDEUTUNG FUER DIE KOHLENGENESE. (THE PRESENT STATE OF OUR KNOWLEDGE OF LIGNIN AND ITS SIGNIFICANCE IN COAL FORMATION.) *Brennstoff-Chemie* (German), **36**, 353-58 (1955) December 7.

The origin of lignin in the phylogenic and ontogenic development of plants is described. The products obtained from a stepwise oxidation of lignin are identified by the use of chromatography and infrared spectroscopy techniques. The importance of lignin in the formation of bituminous coal is discussed.

K. C. Channabasappa

Lignite Gasification

Oppelt, W. H., Kube, W. R., Chetrick, M. H., Kamps, T. W., and Golob, E. F. GASIFICATION OF LIGNITE IN A COMMERCIAL-SCALE PILOT PLANT: PROGRESS REPORT FROM JULY 1, 1950, TO DECEMBER 31, 1951, AND SUMMARY OF WORK PREVIOUS TO JULY 1, 1950. U. S. Bur. Mines Rep. Inv. 5164 (1955) December.

This progress report on the operation of the pilot-plant scale unit for the continuous gasification of lignite covers the period from July 1, 1950 to December 31, 1951, during which time lignite from North Dakota and Saskatchewan, Canada at feed rates of 309 to 681 pounds per hour were gasified with steam. The gasifier is an externally heated retort of alloy steel with an annular space in which down-flowing lignite is gasified by steam introduced at the bottom. Average gasification temperatures were from 1720° F. to 1790° F. Synthesis gases with a CO + H_2 content from 72.3 to 82.1 mole percent were produced at rates from 8,200 to 14,300 CF per hour. Carbon gasified varied from 47 to 86 percent depending on the lignite feed rate. Heat required for external heating of the retort ranged from 28 to 31 percent of the total heat input. Thermal efficiency based on the heating value of product gas was as high as 64.7 percent. An increase in process steam feed rates from zero to 0.7 pounds per pound of moisture-ash-free lignite resulted in an increase of about 30 percent in the carbon gasified and rates of gas generation. The performance of the rolled-plate alloy tube retort for over 4,700 hours of operation was judged to be satisfactory at the combustion-space temperatures used. The pilot plant investigation of lignite gasification was concluded with the completion of the series of runs reported in this progress report. This final report on the experimental work also includes a summary of the earlier results along with general data obtained during the 6-year experimental program.

E. J. Pyrcioch

Mixed Gas Plant

PHILADELPHIA GASWORKS—A DESCRIPTION OF ONE OF ITS STATIONS. Gas J., (British), **285**, 153-58 (1956) January 18.

A complete description of the facilities and method of operation of Station A of the Philadelphia Gas Works (Division of The United Gas Improvement Company). This station is capable for supplying about 200 million cubic feet of 720 Btu gas consisting of a mixture of manufactured gases, including cyclic catalytic reformed natural gas, carbureted water gas and high Btu oil gas, and of purchased gases, including natural gas and coke oven gas. In addition, kerosene can be substituted for natural gas as a feed to the two cyclic catalytic reforming units to make it available for use as an enricher or for the production of natural gas-air mixtures on exceptionally cold days. Liquefied petroleum gas facilities are also available for insurance against a serious natural gas interruption. Storage capacity is sufficient to meet the load on a 3° day without natural gas. The four-shell Hall high Btu oil gas set and a number of carbureted water gas sets are used during the winter months if required. The Hall set also serves as a quick source of high Btu gas in the event of interruption in the supply of natural gas.

H. R. Linden

Oxide Purifiers

Hayston, W. and Wright, D. G. OPERATION AND CONTROL OF DEEP PURIFIERS AT IPSWICH. *Gas J.* (British), **284**, 727, 731-33 (1955) December 14.

This paper deals with the operation and control of a set of five housed purifiers, purifying gas

with a hydrogen sulphide content of up to 1,000 grains per 100 cu. ft. The effects of the high H_2S content of the inlet gas, slow dissipation of heat generated, and atmospheric temperature on the working temperatures and oxide condition are shown. Maldistribution caused by the various bulk densities of the four layers of oxide, due to the various heights of drop when filling is discussed together with the difference of outlet temperatures and H_2S extractions of the two halves of a box when working with split flow. Authors' Abstract

Producer Gas

Grainger, J. A. THE PERFORMANCE OF A WELLMAN-GALUSHA PRODUCER INSTALLATION WITH WHESSOE GAS-CLEANING PLANT. *J. Inst. Fuel* (British), 28, 594-600 (1955) December.

This coke producer-gas installation which supplies the major portion of the gas requirements of a large steelworks consists of nine 10 ft.-diameter Wellman-Galusha producer with cyclone dust-catchers and a Whessoe cleaning plant with gas boosters. Steam for the producer blast is generated in a water-jacket surrounding the producer body. A major advantage of the water jacket is that clinker does not adhere to the cooled walls. Nominally rated for 130,000 CF/hr of gas, the producers were operated continuously at 200,000 CF/hr with little deterioration in gas quality. Operation with coke breeze proved unsatisfactory because of excessive carryover of coke dust and reduced capacity. Dust content of the cleaned gas was kept below 1 gr/CCF when graded coke was gasified. Oxide boxes on hand were insufficient for the removal of H_2S. Soda-ash washing with a wetting agent in the dust removal plant before the boxes was required to keep the H_2S content of the send-out gas at 15-20 gr/CCF. Light oil spraying of the gas at a rate of 1.5 gal/MMCF was effective in dissolving traces of unsaturated hydrocarbons which would otherwise polymerize and form pitch deposits in the distribution system. The cost of coke accounted for over half the total cost per therm of gas. For the fiscal year 1951-52, with an average output of 97 MMCF/week costs in pence per therm were as follows: coke cost: 5.50; other costs: 2.33; total: 7.83. Cleaning cost was 0.872 pence/therm representing 11.4% of the total gas cost. E. J. Pyrcioch

Leffer, F. A. (assigned to Universal Oil Products Co.) PRODUCTION OF COMBUSTIBLE GAS FROM HYDROCARBONACEOUS SOLIDS, PARTICULARLY BITUMINOUS COALS. U. S. 2,727,812 and 2,727,813 (1955) December 20.

These inventions relate to methods for producing water gas, producer gas or synthesis gas from pulverized solid carbonaceous and hydrocarbonaceous materials. In the method applicable to carbonaceous materials, the solid is treated successively in gas producing, heating and final burning gases. The method for hydrocarbonaceous materials, particularly bituminous coals, includes an oxidative destructive distillation treatment of the solids prior to those named for carbonaceous materials.

E. J. Pyrcioch

Suspension Gasification

Fitz, W. DIE ERZEUGUNG VON SYNTHESEGAS DURCH VERGASUNG VON BRENNSTOFFEN ALLER ART NACH KOPPERS-TOTZEK. (THE PRODUCTION OF SYNTHESIS GAS FROM FUELS OF ALL KINDS BY THE KOPPERS-TOTZEK METHOD). *Gas- und Wasserfach* (German), 96, 761-766 (1955) December 1.

The processes for reliable and economic production of synthesis gas have passed through different changes over the years. Their development has already reached a high position in the Koppers-Totzek powder gasification process. Its essential features of construction and operation are described with the notable performance in the 3-year operations of the Finnish gas plant. The operating results demonstrate that such plants can gasify inferior coals, and also oils, with good results. Further plants are building in Japan, Spain and Belgium.

O. P. Brysch

The following article, abstract for which appears on the page indicated, is also called to your attention:

Given, P. H. PRODUCTION OF CHEMICALS FROM COAL AND PETROLEUM. p. 77

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Compression

Sharp, J. M. and Henderson, E. N. COMPRESSOR PIPING DESIGN FOR PULSATION CONTROL AND MAXIMUM COMPRESSOR EFFICIENCY. *Oil Gas J.*, 54, 80-86 (1956) January 9.

Here are results of a 20-company research project into problems of pulsation control. This report shows use of an electrical analog to be the only way to adequately design compressor piping for maximum pulsation control and compressor efficiency by allowing complete prediction of the effect of piping on compressors before installation. No theoretical method will do this and the reasons why are given in this article. The second part, to follow, shows how the analog is used in piping design.

Authors' Abstract

Drilling

Bruno, E. R. SOME OBSERVATIONS ON DRILLING WITH AIR. *Petroleum Eng.*, 28, B21-24 (1956) January.

Field experience and investigations shed more light on down-hole explosions.

Author's Abstract

Dallas, W. W. and Coel, E. J., Jr. NEW DEPTHS REACHED WITH NATURAL GAS. *World Oil*, 142, 109-10, 122 (1956) January.

Drilling in the Delaware Basin, El Paso Natural obtained a 66 percent reduction in drilling costs below 8000 feet. Lost circulation was controlled, and penetration rates increased, by use of gas for drilling to a total depth of 13,792 feet.

B. E. Eakin

Odasz, F. B. and Westfall, M. F. NEW SEALER FOR LOST-CIRCULATION ZONES. *Oil Gas J.*, 54, 72-73 (1956) January 23.

The use of hot liquid asphalt to combat lost circulation problems has proven very effective in the Rocky Mountain region. Hot asphalt pumped down the hole solidifies, sealing the lost-circulation zones. It is also easily drilled out of the hole. B. E. Eakin

McGhee, E. WHERE TO DRILL WITH AIR. PART I. *Oil Gas J.*, 54, 91-93 (1956) January 9.

This two-part article points out many of the possible applications of air drilling and the best technique for using it. The problem of water-shutoff is outlined, and some good tips on successful operations are presented.

B. E. Eakin

Nelson, F. R. and Morrisey, N. S. AIR-GAS DRILLING IS FASTER AND CHEAPER. *Oil Gas J.*, 54, 99-101 (1956) January 16.

Drilling in the Rocky Mountain region is providing rather conclusive evidence that air-gas drilling is faster and cheaper. Reduction in the number of bits required and elimination of low circulation problem are principle factors in the success of this operation. B. E. Eakin

Rosu, G. NEW DRILLING FLUIDS IN THE SOVIET ORBIT. *Oil Gas J.*, 54, 99, 101, 105 (1956) January 2.

From analysis of available literature, and recent Soviet claims of "advanced techniques", the "new methods" appear to be mainly stop-gap measures designed to overcome specific deficiencies. This article is an interesting review of these Russian claims. B. E. Eakin

BASIC RESEARCH SHOWS EFFECTS OF DRILLING FLUID ON PENETRATION OF ROCK BITS. *Petroleum Eng.*, 28, B85-94 (1956) January.

Basic conclusions of an 18-month project were that penetration rates were increased by: 1) rapid removal of chips from the bottom of the hole; and, 2) directing the fluid stream toward the line of contact of bit cutters and the rock. Research also verified Russian findings that the presence of electrolytes in drilling mud aids in making the rock "softer". Editor's Abstract

REVERSE CIRCULATION USED IN NEW VACUUM DRILLING SYSTEM. *Oil Gas J.*, 54, 55 (1956) January 23.

A new idea in air-drilling is sucking the air out the drill pipe rather than forcing compressed air down the pipe. Claims for this system include cooler circulating air, cooler bit operation, 50 per cent lower power requirements, continuous sampling of the cuttings, and elimination of dust. B. E. Eakin

Equilibrium Compositions

Natural Gasoline Association of America. EQUILIBRIUM RATIO DATA BOOK. Tulsa: NGAA, 1955 (?).

Collected in this volume are 137 charts for use in calculating vapor-liquid equilibrium compositions for complex mixtures of hydrocarbons, nitrogen, and hydrogen. Charts of values for nitrogen are presented for convergence pressures of 600, 800, 1000, and 2000 psia, and for the hydrocarbons methane through decane for these and 3000, 4000, 5000, 10,000 and 20,000 psia convergence pressures. Charts for carbon dioxide and hydrogen sulfide at 1000 and at 2000 psia convergence pressure are also included. Temperature ranges include —320 to +100° F. for nitrogen up to +500° F. for the heavier hydrocarbons. Thise volume represent the first publication of a complete set of charts for use with the concept of convergence pressure in reservoir fluid calculations. Convergence pressure, P_k, has been defined as "the pressure at which K's for all components appear to converge to K=1 at the system temperature". The K's are actually continuous up to K=1 only when the equilibrium or system temperature coincides with the critical temperature of the system: at other temperatures the K's for a particular system are actually discontinuous before K=1. This accounts for the phrase "appear to converge". A general discussion of the concept of convergence pressure, and instructions for using the charts are included. Two examples are presented, one illustrating the short-cut method, and the other the long procedure. Special cases where the concept is of limited usefulness are also discussed. The short bibliography of 9 articles directly concerned with convergence pressure calculations is argumented by a selected set of 40 references on phase behavior of mixtures. This volume will be of major importance to the petroleum engineer concerned with calculating phase behavior of complex reservoir fluids. It is intended by the NGAA that additional sheets will be made available as they are calculated from new data.

B. E. Eakin

Fracturing

Henderson, J. H. TECHNICAL TIPS . . . ON SELECTING FRACTURING FLUIDS. *Petroleum Eng.*, 28, B27-30 (1956) January.

Factors to consider when specifying a fluid to fit individual well conditions.

Author's Abstract

Gas Cracking

Schauble, O. C. and Palchik, E. H. (assigned to The Lummus Co.) CRACKING OF HYDROCARBON GASES AND HEATER THEREFOR. U. S. 2,733,287 (156) January 31.

According to the invention, the cracking operation is performed by a heater which includes an elongated mass of refractory material constructed of stacked blocks or tiles. The mass is formed with numerous passages extending longitudinally thereof and with numerous flues extending transversely of said passages and arranged in rows along the passages. The gas charge is passed continuously through the passages and the flues are continuously fired by burners in respective alignment with the flues to heat the charge by conduction through the refractory material. Inventors' Extract

Logging

Weaver, A. G. T. PLANNING A LOGGING PROGRAM. *Petroleum Ref.*, 28, B51-56 (1956) January.

Some practical tips to provide the data you need at minimum cost through careful planning.

Author's Abstract

Pakistan's Gas

ASIA'S LARGEST NATURAL GAS LINE COMPLETED. *Oil Gas J.* 54, 259-60, 63 (1955) December 26.

The Sui-Karachi (Pakistan) pipeline, 348 miles of 16-inch pipe, has been completed in 168 days, 3 weeks ahead of schedule. Initially 37 million CF/day will be delivered, chiefly to power plant and industrial consumers. Later, increased compressor capacity will give 110 million per day, and another 193 mile line to Multan, South Punjab is planned. Handling, welding, coating and testing were done by modern methods. Six wells at Sui supply the gas, and housing, purification plant and 2 Indus River crossings had to be built. O. P. Brysch

FUEL-STARVED PAKISTAN DEVELOPS OWN GAS SUPPLY. *Gas*, 32, 119, 122, 123 (1956) January.

A description of natural gas development in Pakistan. R. F. Bukacek

Pipeline Hydraulics

Lester, C. HYDRAULICS FOR PIPELINERS. *Pipe Line News*, 28, 34-41 (1956) January.

Rotary and centrifugal pump characteristics are described and various graphs showing operating characteristics are given. R. F. Bukacek

Pipeline Planning

Gibbon, A. A 3000-MILE LONG PHOTOGRAPH FOR PACIFIC NORTHWEST. *Pipe Line Industry*, 4, 42-44 (1956) January.

A photograph 3000 miles long was shot to cover the route of the Pacific Northwest pipe line system. The job was so good that only 10 percent of the original right-of-way selected had to be rerouted. Author's Abstract

NATURAL GAS PIPE LINE'S SUNKEN GARDENS. *Pipe Line Industry*, 4, 36-37 (1956) January.

Natural Gas Pipe Line Company has replaced the buried station manifolds at nine of its stations with new manifold pits. They whipped corrosion and made the piping safer. This was an unusual job since the station had to continue operations during construction.

Author's Abstract

NEW COATING SHOWS PROMISE FOR OFFSHORE PIPE LINES. *Pipe Line Ind.*, 3, 20-22 (1955) December.

A new asphalt mastic weight coating with high corrosion resistance has been developed for underwater pipe lines. The coating weighs up to 240 pounds per cubic foot and it can be applied joint-by-joint as the pipe is fed into the water. It looks promising for offshore pipe lines.

Editors' Abstract

Pipeline Survey

Lester, C. B. THE MOLE—LATEST PIPELINE TOOL. *Pipe Line News*, 28, 42-44, 66 (1956) January.

A description of a tool that obtains survey data on a pipeline as it is pulled through the line. This data is periodically logged by photographing the readings of a gyroscope, a bob and arm unit and a clock which indicate horizontal angles, vertical angles, and time respectively. The accuracy of this instrument is ± 10 minutes on a horizontal angle and ± 3 minutes on a vertical angle. It is particularly useful in conducting surveys of underwriter pipelines.

G. G. Wilson

Pulsation Control

Newman, C. and Moerke, N. H. PIPING SYSTEM PULSATIONS . . . AND HOW TO CONTROL THEM. *Petroleum Eng.*, 27, D54-56 (1955) December.

The use of valves, orifices, side-branch resonators, high-pass dampeners, and low-pass dampeners to control pulsations in gas pressure at the outlet of reciprocating compressors are briefly discussed. G. G. Wilson

Sharp, J. M. and Henderson, E. N. PIPING DESIGN FOR PULSATION CONTROL AND MAXIMUM COMPRESSOR EFFICIENCY. PART II. *Oil Gas J.*, 54, 113-18 (1956) January 16.

A discussion of the general features of the Analog computer developed by the Southern Gas Association with Southwest Research Institute for studying pulsation in compressor station piping. R. F. Bukacek

Reservoir Engineering

Buck, J. R. ELEMENTS OF WATER INJECTION. PART 6. *Petroleum Ref.*, 28, B44-48 (1956) January.

Basic guide in dealing with surface and subsurface mechanical problems.

Author's Abstract

Sulfur Recovery

Mortara, M. HOW CONDOR REFINERY RECOVERS SULFUR FROM MIDDLE EAST CRUDES. *Oil Gas J.*, 54, 70-71 (1956) January 23.

The good commercial value of sulfur and the necessity for reduction of air pollution have led to installation of a sulfur recovery plant at the Condor Co. petroleum refinery in Italy.

D. M. Mason

Urban Pipeline

Brundage, H. T. PIPE LINE DOWN MAIN STREET. *Pipe Line Industry*, 4, 38-40 (1956) January.

Building a gas transmission line through densely populated Westchester County outside of New York City brought up special public relations problems. Here is a report of how Tennessee Gas and Bechtel solved them to complete the job without mishap or complaint.

Author's Abstract

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Coking Unit

Kasch, J. E. and Thiele, E. W. DELAYED COKING AND HOW IT'S USED. *Oil Gas J.*, 54, 89-90 (1956) January 2.

Here's a complete story on the inception, development, present use, and future plans for the delayed-coking process. Latest announced installation of this tested process is that at American Oil Co.'s Yorktown refinery. This unit is described. Authors' Abstract

Desulfurizing

Odasz, F. B. and Sheffield, J. V. HIGH-QUALITY GASOLINE AND DIESEL FUEL FROM WYOMING BLACK OILS. *Oil Gas J.*, 54, 64-66 (1956) January 23.

A brief summary of two years' experience with a Catformer operating integrally with a diesulformer. The plant processes heavy high-sulfur crudes. R. F. Bukacek

Distillation Operations

Kalichevsky, V. A. DISTILLATION—METHODS FOR FRACTIONATING CRUDE OIL. *Petroleum Eng.*, 27, C18, 20, 21, 24, 26 (1955) October.

Three types of distillation are discussed: pipe stills, shell stills and vacuum distillation. The author tries to show that considerable skill is required in planning and timing the plant operations. Highly trained technical personnel are needed to tackle scientific problems which the refinery has to meet. J. G. Chalcraft

Shale Oil Industry

Berg, C. ADVANCEMENTS IN FUEL PRODUCTION FROM OIL SHALE. *Chem. Eng. Progress*, 52, 22J-26J (1956) January.

The development of the Union Oil Co. retort is described with details of commercial scale equipment projected for use in Union's five million dollar pilot plant construction program near Grand Valley, Colorado. Refining of the crude shale oil from the retorts will start with coking. Upgrading will then be done by means of the cobalt-molybdate process, or by the Unifining process, followed by catalytic cracking in existing refineries near population centers. Premium Diesel fuel, jet fuel and motor fuel equal to, or better than conventional petroleum projects in quality will be made in over-all yield of 81.5% in liquid products. E. B. Shultz

Prien, C. N., and Savage, J. W. A SHALE-OIL INDUSTRY IS ON ITS WAY. *Chem. Eng. Progress*, 52, 16J-21J (1956) January.

This is a survey of the economic and technical factors involved in the establishing this new industry. All major U. S. oil-shale properties under private ownership are identified with detailed estimates of land costs and descriptions of development activities now occurring. The water problem is considered, most probable retorting and refining methods are discussed, and total product costs are approximated.

E. B. Shultz

7. ANALYTICAL METHODS AND TESTS

Adsorption Fractionation

Mair, B. J., Montjar, M. J., and Rossini, F. D. FRACTIONATION OF HYDROCARBONS BY ADSORPTION WITH ADDED COMPONENTS. *Anal. Chem.*, 28, 56-61 (1956) January.

An improved method is described for separating hydrocarbons by adsorption, in which the fractionation takes place in the presence of two added components, one in the adsorbed phase and one in the liquid phase. Results are reported for experiments in which ethylene glycol monoethyl ether, or diethylene glycol monomethyl ether, constitutes the added component in the adsorbed phase, and heptacosafluorotributylamine, or perfluorocyclic ether constitutes the added component in the liquid phase. The meth-

od is particularly effective for the separation of branched paraffins from cycloparaffins.

Authors' Abstract

Coal Composition

Friedel, R. A., and Queiser, J. A. INFRARED ANALYSIS OF BITUMINOUS COALS AND OTHER CARBONACEOUS MATERIALS. *Anal. Chem.*, 28, 22-30 (1956) January.

Spectral studies on the chemical composition of coal are given. Experimental techniques, spectral band assignments, and a comparison of coal with coal products and with other carbonaceous materials, are included. A spectral study of residues from the vacuum distillation of coal is also given. E. Mann

Mine Air Analysis

Watson, H. A. and Berger, L. V. EQUIPMENT FOR ANALYZING MINE ATMOSPHERES, WITH SPECIAL REFERENCE TO HALDANE-TYPE APPARATUS. U. S. Bur. Mines Inf. Circ. 7728 (1956) January.

This circular presents information on the different types of equipment that may be used to analyze mine atmospheres, with particular reference to the application and limitations of each type. Since the Haldane-type apparatus is particularly applicable to the accurate determination of carbon dioxide, oxygen, and combustible gases such as methane in mine atmospheres, that apparatus and the method of operation are described in detail. The circular presents results of a critical study of the accuracy attainable with the Haldane-type apparatus. Analytical procedures involved in the other methods discussed are presented in publications referenced in this circular. Information is given also on the various accessory equipment needed in a laboratory for the suggestions on laboratory design are included. Authors' Abstract

Oxygen Determination

Kallen, H. OXYGEN ANALYSIS FOR COMBUSTION CONTROL. *Power*, 100, 90-91 (1956) January.

Limitations of combustion controls based on steam-flow : air-flow ratio, fuel-flow : air-flow ratio, and CO_2 control of flue gas are discussed. Oxygen content of flue gas is shown to be relatively constant for different fuels and therefore very suitable as a basis of control. With the advent of new and improved instruments, oxygen analyzers are findings wide use, especially with varying quality fuels, but also with constant quality fuels as a check on other methods of control. Commercial oxygen analyzers, including sampling and sample-cleaning systems are described with examples of use.

D. M. Mason

Stafford, C., Puckett, J. E., Grimes, M. D. and Heinrich, B. J. COLORIMETRIC DETERMINATION OF LOW CONCENTRATIONS OF OXYGEN IN GASES. *Anal. Chem.*, 27, 2012-15 (1955) December.

A rapid and accurate colorimetric method is given for the determination of oxygen in the range of 0 to 100 p.p.m. in various hydrocarbon gases. E. Mann

True Vapor Pressure

Tomsic, W. J. DETERMINING TRUE VAPOR PRESSURES. *Petroleum Eng.*, 28, C29-30, 32 (1956) January.

True vapor pressures for natural gasolines are normally calculated from fractional analysis. For some liquids, such as crude oils, fractional analysis of the highly volatile trace components are difficult to obtain with sufficient accuracy. Reid vapor pressures and true vapor pressures of crude oils are known to differ by as much as 1000 per cent. Hence, the Reid vapor pressure cannot be used in place of the true vapor pressure. A test method has been developed for determining the true vapor pressure of hydrocarbon liquids. Test consists of superimposing an external pressure on the liquid in excess of true vapor pressure. The external pressure is gradually reduced until the bubble point is reached as determined by visual observation. Results are reported as the true vapor pressure in pounds per square inch at 100 F. Test uses readily available equipment and is simple to conduct. Excellent reproducibility has been obtained. The test method has been checked against vapor pressures calculated from fractional analysis and from known temperatures and pressures in accumulators with excellent results. A few of the potential uses for the true vapor pressure method are discussed.

Author's Abstract

8. GENERAL AND PHYSICAL CHEMISTRY

Carbon Adsorption

Beebe, R. A. and Dell, R. M. HEATS OF ADSORPTION OF POLAR MOLECULES ON CARBON SURFACES. II. AMMONIA AND METHYLAMINE. U. S. Dept. of Commerce PB 111708 (1954) August.

Isotherms in the temperature range from —78° to —22° C. have been measured for ammonia on representative members of a series of carbon blacks graphitized at successively higher temperatures up to 2700°; and heats of adsorption for ammonia on these blacks have been calorimetrically determined at —78°. A limited number of experiments have been done with methylamine. Authors' Abstract

Data Evaluation

Rachford, H. H., Jr. Schultz, W. P. SOME USEFUL TABLES FOR APPROXIMATING SMOOTH CURVES BY FIFTH-AND-LOWER DEGREE POLYNAMIALS. T. N. 321. *J. Petroleum Techn.*, 7, 43-44 (1955) December.

Tables are presented for simplifying a least squares fit for data expressible by fifth-and-lower degree polynomials. To use these tables, the data must be smoothed, so that function values can be obtained at equal intervals of the argument. S. A. Weil

Graphite Oxide Spectra

Hadzi, D. and Novak, A. INFRA-RED SPECTRA OF GRAPHITIC OXIDE. *Faraday Soc. Trans.*, 51, 1614-20 (1955) December.

Infra-red spectra of graphitic oxide and derivatives are presented and interpreted. It is possible to identify bands arising from various vibration modes of COH groups. The stretching frequency of the OH groups belonging to graphitic oxide (3430 cm^{-1}) is different from that of intercalated water molecules (3250 cm^{-1}). Attempts at exchanging hydroxylic hydrogen for deuterium in graphitic oxide have failed. Authors' Abstract

Heat Transfer

Zimmermann, F. J. TOTAL EMISSIVITIES AND ABSORPTIVITIES OF SOME COMMERCIAL SURFACES AT ROOM AND LIQUID-NITROGEN TEMPERATURES. *J. Appl. Phys.*, 26, 1483-88 (1955) December.

The heat transferred by radiation was measured between surfaces at room temperature and liquid-nitrogen temperature. The surfaces used were various combinations of electroplated gold and silver and polished copper sheet. From the test data, the approximate total emissivities of the room-temperature surfaces and the total absorptivities of the liquid-nitrogen surfaces were computed. The results of these tests indicated that electroplated silver surfaces have lower emissivities and absorptivities than equivalently treated electroplated gold surfaces in this temperature range. The best surface tested was a special, bright, unbuffed silver-plated surface. This surface is known to the trade as "silver lume." The room-temperature emissivity of this surface was approximately 0.017, and the absorptivity at 77.3° K for radiation from a 300° K surface was about 0.0083. These are the lowest values at these temperatures of which we have knowledge. It was found that the electroplated surfaces were best used without buffing or any mechanical working of the surface. It is believed that cold working of the metal surface increases its emissivity and absorptivity by increasing its electrical resistivity. Author's Abstract

Hydrocarbon Adsorption

Walters, C. J. CHARCOAL ADSORPTION EQUILIBRIA FOR LIGHT HYDROCARBONS. *Ind. Eng. Chem.*, 47, 2544-47 (1955) December.

The adsorption of the heavier hydrocarbons on the activated charcoal has been used for years by the petroleum industry in field and laboratory testing of natural gas. The work reported in this article was an attempt to obtain vapor-adsorbate equilibria data for light hydrocarbon mixtures in order to evaluate the commercial possibilities of this method for the separation of gas mixtures. Data on two binary and a ternary system are reported. B. E. Eakin

Mass Transfer

Garner, F. H. and Hale, A. R. SOLUTE TRANSFER TO AND FROM LIQUID DROPS. *J. Appl. Chem.* (British), 5, 653-63 (1955) December.

Mass-transfer data are presented for the four

systems with water and toluene as solvents and diethylamine as the solute, including transfer of diethylamine to and from toluene drops rising through water and to and from water drops falling through toluene. The rate of transfer is dependent upon the direction of diffusion and upon which phase is dispersed. The transfer of diethylamine from a continuous water phase to toluene drops was found to be extremely susceptible to contamination.

Authors' Abstract

Urea Adducts

Calderbank, P. H. and Nikolov, N. S. THE UREA-HYDROCARBON ADDUCTS. J. Phys. Chem., 60, 1-6 (1956) January.

The utilization of adduct formation in hydrocarbon separation processes has been developing in recent years, and now these complexes have been studied by means of the phase rule and calorimetric measurements. It was found that the solvent for urea (water or methanol) has no other function than that of precipitating solid urea, and it was concluded that adduct formation is a two-phase interaction involving solid urea. Adduct formation was observable only when particle size was less than a certain critical value. Then transition from tetragonal to hexagonal solid urea occurs, and straight chain hydrocarbons begin to diffuse into the crystal lattice at measurable rates, following diffusion laws. Values of diffusivity, and energy requirements are presented. From the phase diagrams the authors show that complete separations are not always possible, for instance, separation of n- and iso-octane is possible to about 4% octane, explaining the limited success in improving gasoline octane ratings by urea extraction. E. B. Shultz

9. ORGANIC CHEMISTRY

Canadian Ammonia

Brown, E. C. and Stewart, A. R. PRODUCTION AND CONSUMPTION OF AMMONIA IN CANADA. *Can. Chem. Processing*, 39, 58-62 (1955) November.

This article discusses the growth of the ammonia industry in Canada and the methods of manufacture. Prior to 1940 the well-established coke process provided most of the hydrogen for the catalytic, high-pressure synthesis of ammonia. Advanced technology replaced coke by natural gas (steam reforming and oxygen for partial oxidation). The latter method also provides an economic method of making ammonia from fuel oil. A. J. Tulis

Carbonyl Sulfide

Easthagen, J. H. and Allen, H. I., Jr. (assigned to California Research Corp.) PROCESS FOR REMOVING CARBONYL SULFIDE FROM LIQUEFIED PETROLEUM GASES. U. S. 2,726,992 (1955) December 13.

Carbonyl sulfide in liquefied petroleum gases is removed by contacting with diethanolamine in aqueous solution of preferred concentration of 15 to 25%. A contact time of 1 to 20 seconds is reuired for 99% removal when the hydrocarbon is in liquid phase. The diethanolamine is regenerated by heating and stripping with steam. D. M. Mason

Morningstar, R. E. (assigned to Olin Mathieson Chemical Corp.) PROCESS FOR THE MANUFACTURE OF CARBONYL SULFIDE. U. S. 2, 728,638 (1955) December 27.

Carbonyl sulfide is produced by passing SO_2 and CO through a body of particle-form coke maintained at a temperature preferably from about 1400° F. to 1800° F. and at a space velocity from 3 min^{-1} to 100 min^{-1}.

D. M. Mason

Ethane-Propane Pyrolysis

STEAM CRACKING EXTENDED TO ETHANE, PROPANE FEED STOCKS. *Oil Gas J.*, 54, 113-14 (1956) January 2.

Pilot-plant data are given on the Kellogg process for steam pyrolysis of ethane and propane to high-priority ethylene for petrochemical purposes. Conversion of 45 wt percent of ethane and 29 wt percent of propane to ethylene are reported. A break down of operating costs and an overall economic summary in tabular form are presented. E. B. Shultz

Nitroparaffins

Reidel, J. C. PROPANE TO NITROPARAFFINS. *Oil Gas J.*, 54, 110-14 (1956) January 9.

The nitroparaffin plant of Commercial Solvents Corp. is described in a special petrochemical report. An excess of propane is reacted with nitric acid in an adiabatic reactor employing

nitric acid sprays. The heat of reaction is used to preheat and vaporize the nitric acid. Temperatures about 770° F. and pressures about 115-175 psi are used. Products recovery, purification and separation are described.

E. B. Shultz

Organic Chemicals

Given, P. H. THE PRODUCTION OF CHEMICALS FROM COAL AND PETROLEUM. (Review No. 154) *British Coal Utilizn. Research Assoc. Monthly Bull.* 19, 589-606 (1955) December.

Selected production figures are given for basic organic chemical raw materials and chemical intermediates which the world consumes as modern manufactured goods. Data for 1945 to 1953 production in important countries are given for: — plastics and fibres, plasticizers, synthetic rubber, detergents, automotive chemicals, insecticides, weed-killers, dyestuffs, lakes, toners, medicinals and solvents. The consumed chemicals or intermediates are compared. Raw materials and their sources in the coke, gas and petroleum industries are discussed, with data, and present day research on new sources is reviewed.

O. P. Brysch

10. CHEMICAL ENGINEERING

Cooling Towers

Smith, A. FORCED DRAFT COOLING TOWER STAGES A COMEBACK. *Oil Gas J.*, 54, 73-4 (1955) December 19.

Limitations of earlier forced-draft cooling towers in reactor air distribution and recirculation of discharged vapor (with resultant effect on cooling ability) have now been overcome.

Author's Abstract

Dust Scrubber

Smith, L. B. (assigned to Fly Ash Arrestor Corp.) GAS SCRUBBER. U. S. 2,728,409 (1955) December 27.

A gas scrubber design is patented in which the gas is contacted with water for the removal of solids such as fly ash.

W. G. Bair

Heat Transfer

Levine, C. A. and Opler, A. COMPUTER SOLVES HEAT FLOW PROBLEMS. *Chem. Eng.*, 63, 203-06 (1956) January.

A general discussion is presented of the use of a simple monodimensional conduction problem and one involving streamline flow of a reacting fluid through an experimental reactor.

R. T. Ellington

Plant Wastes

Farrar, G. L. SOCONY-MOBIL REFINERY USES EVAPORATION POND FOR WASTE WATER. *Oil Gas J.*, 54, 75-6 (1955) December 19.

All of the waste water from Socony's Casper, Wyo., refinery now runs into an evaporation pond after treatment in the plant.

Author's Abstract

Glueckauf, E. THE LONG-TERM ASPECT OF FISSION PRODUCT DISPOSAL. *Chem. and Process Eng.* (British), 37, 23-27 (1956) January.

The article discusses the general problem of disposal of waste products from nuclear fission.

W. G. Bair

Plate Efficiency

Foss, A. S. and Gerster, J. A. LIQUID-FILM EFFICIENCIES ON SIEVE TRAYS. *Chem. Eng. Progress*, 52, 28J-34 (1956) January.

The stripping of oxygen from water flowing across perforated plates by atmospheric air passing up through the plates was studied. The most important fundamental factors affecting liquid film plate efficiency were found to be the total amount of interfacial area within the froth, and the time of contact of the liquid with the gas.

R. F. Bukacek

Reactor Design

Corrigan, T. E. and Young, E. F. REACTOR DESIGN FOR COMPLEX REACTIONS. *Chem. Eng.*, 63, 207-12 (1956) January.

Rate equations are developed for simple series and parallel reactions with and without backmixing.

R. T. Ellington

Sulfur Combustion

Merriam, H. F. and Hurmence, H. H. (assigned to Allied Chemical and Dye Corp.) PRODUCTION AND USE OF SULFUR DIOXIDE. U. S. 2,726,933 (1955) December 13.

Sulfur is burned to SO_2 by submerged combustion in a relatively deep pool of liquid sulfur maintained at auto ignition temperature, preferably about 550-650°F. The combustion gases

are cooled to remove sulfur vapor by spraying cooled sulfur at about 250-310°F into the space above the pool, thus obtaining countercurrent contact with the gases leaving the pool.

D. M. Mason

Thermodynamics

Van Ness, H. C. THERMODYNAMICS FOR PROCESS EVALUATION. *Petroleum Ref.*, 35, 165-68 (1956) January.

The second law of thermodynamics is presented in a form useful for engineering calculations. The article shows how thermodynamics can be used in simplified form for the evaluation of a process. Two illustrative examples are given. B. E. Eakin

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Boiler Water Heater

Kotelewskij, G. P. BUBBLE CONTACT HEATERS FOR POWER PLANTS. *Ind. Eng. Chem.*, 48, 20-25 (1956) January.

A boiler feed water heater uses the contact system of heating by bubbling medium pressure waste steam through the feed water. Several advantages are claimed. W. G. Bair

Bourdon Tubes

Jennings, F. B. THEORIES ON BOURDON TUBES. *Amer. Soc. Mech. Eng. Trans.* 78, 55-64 (1956) January.

Various theories of Bourdon tube performance are compared and the results plotted in terms of dimensionless ratios. Experimental data are compared with the author's simplified theory and an empirical curve of similar shape is drawn. R. F. Bukacek

Mason, H. L. SENSITIVITY AND LIFE DATA ON BOURDON TUBES. *Amer. Soc. Mech. Eng. Trans.* 78, 65-77 (1956) January.

Information supplied by manufacturers to the Empirical Data Subcommittee of the ASME Research Committee on Mechanical Pressure Elements is presented in tabular and graphic form. Sensitivities are compared with the theories of Wuest, Wolf, and Clark-Gilroy-Reissner. Plots of life data as a function of maximum fiber stress as shown for steel and for phosphor bronze. Author's Abstract

Instrumentation

Marvin, R. G., Stuart, W. L., Lunsford, G. W. and Ludwig, E. E. NEW PETROCHEMICAL INSTRUMENT APPLICATIONS. *Oil Gas J.*, 54, 110-13 (1955) December 5.

Dow Chemical Co. gives its experience with: 1) digital and analog computers, 2) relative flow measurement at high pressure, 3) ratio flow control of two gas streams in a process, 4) use of strain cell for pressure control, 5) control of an absorption refrigeration system, 6) sealed meter-force balance type, and 7) flow measurement of high-balance gas streams with impeller-type flow-sensing cell.

Authors' Abstract

Pumps

Applegate, F. B. MECHANICAL ENGINEERING — THE CHOICE DESIGN, CHARACTERISTICS AND MAINTENANCE OF CENTRIFUGAL PUMPS. PART III. *Petroleum Eng.*, 27, C31-36 (1955) December.

Part 3 of on refining fundamentals, this article deals with centrifugal pumps in their application to the pumping of liquids. R. F. Bukacek

Wise, W. M. PREVENTIVE MAINTENANCE OF PROCESS PUMPS. *Petroleum Ref.*, 35, 121-22 (1956) January.

In one refinery of the Sun Oil Company it was found that an annual internal inspection of pumps produced the lowest overall maintenance cost per unit. Details of the inspection report form are given. W. G. Bair

12. MATERIALS OF CONSTRUCTION

Cathodic Protection

Bellassai, S. J. INDUCED ALTERNATING CURRENT USED FOR CATHODIC PROTECTION OF A COATED PIPE LINE. *Corrosion*, 12, 17-19 (1956) January.

After repairing a leak on a coated line through a salt marsh that paralleled a high voltage power line, tests were run to determine if rectification of induced AC current had caused the corrosion. These tests indicated that such rectification was not the cause of the corrosion, but the induced AC was of such magnitude that it was rectified by means of a rectifier and ground bed to provide cathodic protection for the pipeline. G. G. Wilson

Coatings

Warring, R. H. TODAY'S WIDE RANGE OF TREATMENTS PROVIDES A COMPREHENSIVE SERVICE FOR METAL FINISHERS. *Ind. Finishing* (British), **9**, 322-30 (1956) January.

A comprehensive presentation of the basic treatments and processes that have been developed for finishing, treating and protecting metal surfaces. Tables describing proprietary phosphating processes, and proprietary treatments for aluminum surfaces are included.

G. G. Wilson

Watson, D. A. SPRAYED METAL COATING IN PRODUCT DESIGN. *Materials and Methods*, **42**, 106-09 (1955) December.

The physical properties of a number of sprayed metals are discussed and tabulations of hardness and tensile strength of some sprayed metals are presented. Surface preparation requirements of metallic and non-metallic surfaces prior to metallizing are also briefly noted.

G. G. Wilson

35 MILES OF LINE CLEANED AND COATED IN PLACE IN ONE OPERATION. *Pipe Line Ind.*, **3**, 40-41 (1955) December.

The longest line ever coated internally in place is a 35-mile stretch of 8-inch and 10-inch pipe line in West Texas. The line was cleaned and coated internally with epoxy resin. Radioactive cobalt inserted in the coating pig enabled operators to exercise precise control over the operation. Editor's Abstract

Flue Gas Corrosion

Coit, R. L. SULPHUR DEW-POINT CORROSION IN EXHAUST GASES. *Amer. Soc. Mech. Eng. Trans.*, **78**, 89-94 (1956) January.

Sulphur dew-point corrosion continues to be an important problem in steam-power stations and some gas turbine applications. A series of corrosion tests is described in which it was found that the effects of this type of corrosion can be minimized by a) use of certain corrosion resistant alloys such as Hastelloy C, Carpenter No. 20, or Type 316 stainless steel; b) the use of low-sulphur fuels; or c) the maintenance of surface temperatures above the acid-water dew point. The tests indicate that none of the presently available coating materials can provide adequate low-temperature corrosion protection for heat-exchanger surfaces or compressor blading. Author's Abstract

Fire Protection

HOW TRANSCO ISOLATES OUTSIDE FIRES. *Pipe Line Industry*, **4**, 34-35 (1956) January.

A newly-installed system at Transcontinental's New York City metering station literally will blanket the station with fog less than 30 seconds after a fire is observed in the area. Water purchased from the city's main is distributed by 40 fog nozzles at the rate of 1200 gallons per minute to prevent damage to the vital installation. Author's Abstract

Hydrogen Corrosion

Backensto, E. B., Drew, R. D. and Stapleford, C. C. HIGH TEMPERATURE HYDROGEN SULFIDE CORROSION. *Corrosion*, **12**, 22-23 (1956) January; *Petrol. Refiner*, **35**, 147-50 (1956) January.

The results of laboratory investigations of the effect of temperature, pressure, and hydrogen sulfide concentration on the corrosion rate of a wide range of commonly used carbon steels and alloys are presented. Of the materials tested, only the 18-8 chrome nickel and higher alloys and aluminum coated steels showed good resistance to this type of corrosion over a wide range of pressure, temperature, and hydrogen sulfide concentration. G. G. Wilson

King, G. R. HOW TO REDUCE HYDROGEN ATTACK. *Petroleum Refiner*, **35**, 124-28 (1956) January.

In order to minimize hydrogen attack in fluid catalytic cracking units and associated equipment several techniques may be applied. The limitations of concrete protective liners are mentioned. Experiments are described on water washing with acid and air injection to remove and react the cyanide compounds which arise from cracking of heavy, nitrogen-containing feed stocks, and act as accelerators for hydrogen attack. By injection of air, cyanides may combine with any hydrogen sulfide present, and oxygen in solution, to form harmless ammonium thiocyanate. Hydrogen penetration data under various conditions are given. E. B. Shultz

Insulating Joints

Pearson, E. T. TEST METHODS TO DETERMINE THE RESISTANCE OF AN INSULATING JOINT. *Corrosion*, 11, 535t-41 (1955) December.

Test methods for determining the resistance of an insulating joint under a number of conditions are discussed. Consideration is given to the purposes for which insulating joints are commonly used. A detailed study is made of the problem of determining the true resistance of an insulating joint installed between two buried structures when a direct, accurate current measurement is not possible on either structure at the point. The parallel computation, delta computation and the null circuit methods are discussed in connection with this problem. Author's Abstract

Refractories

OXIDE AND SILICON CARBIDE COATINGS FOR HIGH TEMPERATURE RESISTANCE. *Ind. Heating*, 22, 2352-60 (1955) November.

Adherent, highly refractory coatings of oxides such as aluminum oxide or zirconium oxide formed on the surface of metals such as steels, alloys and aluminum, and silicon carbide coating for graphite, are recent developments of Norton Co., Wooster, Mass. The purpose of the coatings is to protect the base material against erosion and insulate thermally.

Editor's Introduction

Welding

Thomas, R. D., Jr. CONSUMABLE INSERT TECHNIQUE FOR PIPE WELDING. *Pipe Line News*, 28, 28-31 (1956) January.

A completely reliable root-pass welding technique for hand or machine, as required in piping for radioactive fluids, has been developed by the Electric Boat Division of General Dynamics Corp. The method utilizes a consumable insert ring, of special cross-sectional shape and controlled metal composition, fitted up between the machined or ground pipe-ends without a backup, and welded under a localized internal inert purge by a inert-gas tungsten arc. The internal surface contour is not influenced by gravity or by internal gas pressure because of tension forces while the ring metal is molten, and forms a sound, smooth root-pass upon which the weld can be completed by usual practice. Weld metal composition, structural strength and crevice corrosion are thus closely controlled.

O. P. Brysch

13. NEW BOOKS

(C. A. Simms, Librarian)

Natural Gas

Henshaw, R. C., Jr., NATURAL-GAS STATISTICS. Austin: University of Texas, 1955.

A supplement to an earlier book: Stockton, J. R., Graves, R. W. and Henshaw, R. C., Jr., "Economics of natural gas in Texas," published by the University of Texas in 1952. Many tables, charts and figures have been brought up to date, and in some cases entirely new tabulations have been made.

Transportation

Hennes, R. G. and Ekse, M. I., FUNDAMENTALS OF TRANSPORTATION ENGINEERING. New York: McGraw-Hill Book Co., 1955.

Contains one section of the design and layout of pipeline facilities.

Calculus

Menger, Karl, CALCULUS; A MODERN APPROACH. Boston: Ginn and co., 1955.

Lecture notes as used by Dr. Menger at the Illinois Institute of Technology to present calculus in a clarified conceptual frame.

Organic Analysis

Shriner, R. L. et al., THE SYSTEMATIC IDENTIFICATION OF ORGANIC COMPOUNDS; A LABORATORY MANUAL. 4th ed. New York: John Wiley & Sons, 1956.

A revision of a very popular laboratory manual. There is a new chapter of infrared and ultraviolet spectroscopy.

Fluid Handling

Molloy, E., Editor, FLUID HANDLING. London: George Newnes, Ltd., 1955.

Some of the most important and up-to-date information of fluid handling has been brought together in book form.

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American Chemical Society. Journal
American Gas Association Monthly
American Gas Journal
American Petroleum Institute Quarterly
American Society for Testing Materials Bulletin
American Society of Mechanical Engineers. Transactions
Analytical Chemistry
Appliance Manufacturer
Applied Spectroscopy
Association for Computing Machinery, Journal
Australian Journal of Applied Science
Australian Journal of Chemistry

Bituminous Coal Research Reports
Brennstoff-Chemie
British Coal Utilization Research Association Monthly Bulletin and Quarterly Gazette
Butane-Propane News

California Oil World
Canadian Chemical Processing
Canadian Gas Journal
Canadian Journal of Chemistry
Canadian Journal of Physics
Canadian Journal of Technology
Chemical and Engineering News
Chemical and Process Engineering
Chemical Engineering
Chemical Engineering Costs Quarterly
Chemical Engineering Progress
Chemical Engineering Science
Chemical Processing
Chemical Reviews
Chemical Society (London) Journal
Chemical Week
Chemistry and Industry
Coal Heat
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Corrosion

Drilling

Engineers' Digest
Erdöl und Kohle

Faraday Society. Transactions
Fuel
Fuel Efficiency
Fueloil and Oil Heat

Gas
Gas Age
Gas and Oil Power
Gas Council (British) Publications
Gas Heat
Gas Journal
Gas Times
Gas und Wasserfach
Gas World

Heating, Piping and Air Conditioning

Independent Petroleum Association of America Monthly
Industrial and Engineering Chemistry
Industrial Finishing
Industrial Gas (American)
Industrial Gas (British)
Industrial Heating
Institute of Fuel (British). Journal
Institute of Gas Technology Publications
Institute of Petroleum (British). Journal
Institution of Gas Engineers. Bulletins, Communications and Transactions
Instruments

Jet Propulsion
Journal des Usines a Gaz
Journal of Applied Chemistry
Journal of Applied Mechanics
Journal of Applied Physics
Journal of Chemical Physics
Journal of Metals
Journal of Organic Chemistry
Journal of Petroleum Technology
Journal of Physical Chemistry
Journal of Research (National Bureau of Standards)
Journal of Scientific Instruments

Laboratory Practice
LP-Gas
Lubrication

Materials and Methods
Mathematical Aids
Mechanical Engineering
Mining Engineering

National Advisory Committee for Aeronautics, Reports
National Fire Protection Association Quarterly
National Gas Bulletin of Australia
National Petroleum News

Official Gazette of the U.S. Patent Office
Oil and Gas Journal

Petroleum
Petroleum Engineer
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Physics Today
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